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STORMWATER MANAGEMENT REPORT

Prepared For

PROPOSED SITE DEVELOPMENT

72 DEEPWOOD ROAD, DARIEN, CT

June 29, 2021

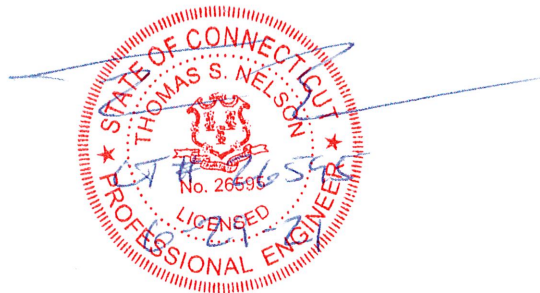


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1. INTRODUCTION

McChord Engineering Associates, Inc. has been commissioned by Dominic DeMattia to perform stormwater management computations for the proposed site development at 72 Deepwood Road in Darien, Connecticut. The property consists of 1.345-acres and is located in Darien's R-1 residential zone. It is in the Noroton River watershed basin and outside of any public water supply watersheds. Figure 1 shows the location of the property on the United States Geological Survey (USGS) map.

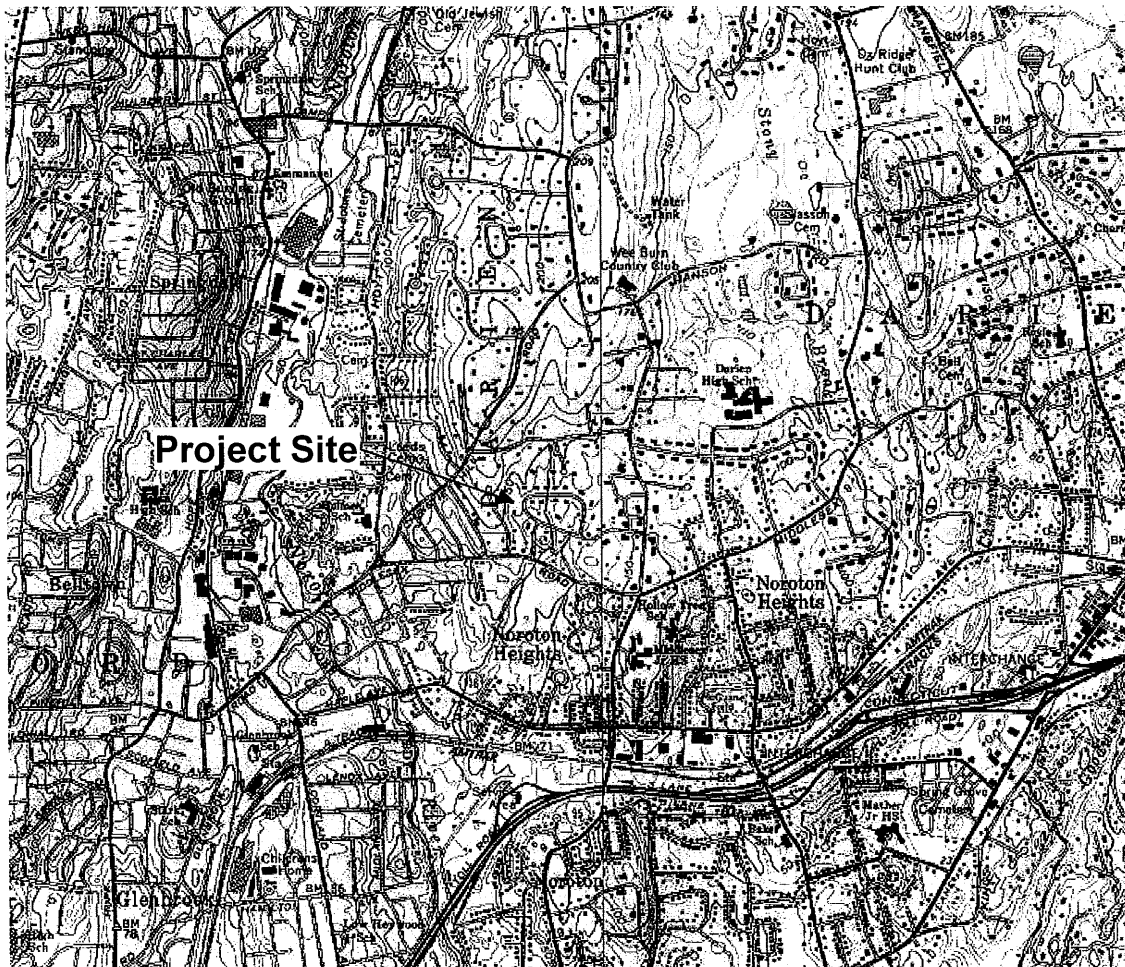


Figure 1: Location Map

The property is currently developed with a single family residence, driveway, patio and lawn. There is an underground detention system that controls runoff from the residence and driveway. There are inland wetlands that encompass the southern and western portions of the property. Topography on the site consists of gradual slopes that drain toward the wetlands. The property is currently served by town sewer and water.

The proposed site development includes the construction of a pool, spa and expanded patio. The existing underground detention system will be expanded to control runoff from the proposed development. Erosion and sedimentation controls will be employed to protect the inland wetlands during construction.

2. SCOPE OF STUDY

This stormwater management report contains studies comparing peak rate of runoff between the existing conditions and the proposed development to ensure that the proposed development will have no adverse impact on adjoining property owners or downstream drainage systems. The site will be developed with its own on-site stormwater management system capable of controlling the increase in peak runoff.

3. ANALYSIS METHODOLOGY

Runoff was modeled with HydroCAD 8.50 software produced by HydroCAD Software Solutions LLC. This software uses the NRCS TR-20 method for analyzing stormwater runoff. Soil characteristics, cover conditions, slope, time of concentration, and historical rainfall data are all parameters that are utilized by this method. The analysis considered the 2, 10, 25 and 50-year storm events. Precipitation depth for each storm event was taken from the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 Point Precipitation Frequency Estimates specific to the subject property.

4. STORMWATER MANAGEMENT STRATEGY

Currently, the stormwater runoff on-site is controlled by an existing detention system. Runoff from the driveway is captured by a driveway drain and conveyed to the detention system. Rooftop runoff is captured by roof leaders and conveyed to the detention system. Runoff from the remainder of the property that is not captured flows overland to the inland wetlands.

The existing stormwater management system will be expanded to control the increase in runoff from the proposed development. Rooftop and driveway runoff will continue to be routed to the detention system. Runoff from a majority of the expanded patio will be captured by a strip drain and conveyed to the detention system. The existing detention system consists of eighteen (18) units of 24" high x 48" wide x 96" long precast concrete galleries surrounded by crushed stone with a storage capacity of approximately 1,295 cubic feet. The proposed expanded detention system consists of twenty-three (23) units of 24" high x 48" wide x 96" long precast concrete galleries surrounded by crushed stone with a storage capacity of approximately 1,680 cubic feet. During typical storm events, stormwater will infiltrate into the underlying soils and there will be no surface discharge from the detention system. An existing high level overflow grate will provide relief during extreme storm events. Runoff from the remainder of the property will continue to flow overland to the inland wetlands conforming to existing conditions.

Detailed information on the size and configuration of the proposed stormwater management measures is available on the most recent revision of the "Site Development Plan" prepared by this office. A Stormwater Facilities Maintenance Plan is also included in Appendix C.

5. ANALYSIS & RESULTS

5.1 PEAK FLOW CONTROL

Runoff from the property was analyzed under existing and proposed conditions. The existing conditions analysis modeled the entire site as a whole. The proposed conditions analysis divided the property into area that is detained through the proposed detention system and undetained areas. The proposed runoff that is not detained will sheet flow towards the wetlands conforming to existing conditions.

Using the NRCS TR-20 method, the peak rate of runoff for the 2, 10, 25 and 50-year storm event was computed for the site. Soils on the property were determined using the NRCS Web Soil Survey. Cover conditions were derived from site observations and the "Site Development Plan" prepared by this office. Soil testing was performed when the stormwater management system was first proposed in 2018 and confirmed suitable infiltration rates. The resulting peak flow rates under both the existing and proposed conditions are summarized in Table 1. For detailed computations see Appendix A.

Table 1: Peak Flows

Storm Event	Existing		Proposed	
	Rate (cfs)	Volume (ft ³)	Rate (cfs)	Volume (ft ³)
2-year	1.00	3,646	1.00	3,616
5-year	2.17	7,645	2.13	7,469
10-year	2.95	10,669	2.87	10,474
25-year	3.57	13,176	3.45	12,976

The analysis shows that there is no increase in the peak rate of runoff from the property during any of the analyzed storm events.

5.2 WATER QUALITY

The stormwater management system was also designed with an emphasis on water quality. The detention system was sized to accommodate the Water Quality Volume (WQV) of the runoff that is routed to it. The methods outlined in the Connecticut Stormwater Quality Manual were used to determine the WQV. Collecting the WQV and allowing it to infiltrate into the soils provides filtration of the runoff and is an effective means of stormwater renovation. The treatment capacity of the detention system and the WQV required is summarized in Table 2. For detailed computation see Appendix B.

Table 2: WQV Sizing

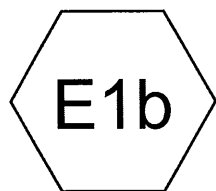
System Description	WQV (ft ³)	Volume Provided Below Overflow Grate (ft ³)
184 LF of 24"x48" Concrete Galleries	650	1,680

The analysis shows that the proposed detention system is sufficiently sized to treat runoff from the proposed development for water quality purposes.

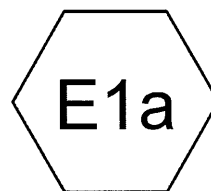
6. CONCLUSIONS

Based on our analysis, McChord Engineering Associates, Inc. has demonstrated that the proposed stormwater management system will adequately control the increase in runoff from the proposed development at 72 Deepwood Road in Darien, Connecticut. It is the opinion of this office and the conclusion of this report that the proposed site development will have no adverse impacts to the adjoining property owners or any downstream drainage systems.

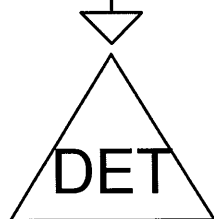
APPENDIX A:
PEAK FLOW COMPUTATIONS



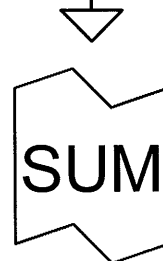
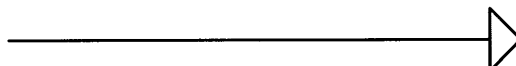
Detained Area



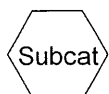
Undetained Area



Detention System



Sum Hydrographs



Existing Conditions - 72 Deepwood

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
23,638	74	>75% Grass cover, Good, HSG C (E1a)
8,475	76	Woods/grass comb., Fair, HSG C (E1a)
2,785	98	Driveway (E1b)
305	98	Front Walkways (E1a)
665	98	Rear Patio (E1a)
3,610	98	Rooftop (E1b)
345	98	Undetained Driveway (E1a)
39,823		TOTAL AREA

Existing Conditions - 72 Deepwood

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Type III 24-hr 50-yr Rainfall=7.40"

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Summary for Subcatchment E1a: Undetained Area

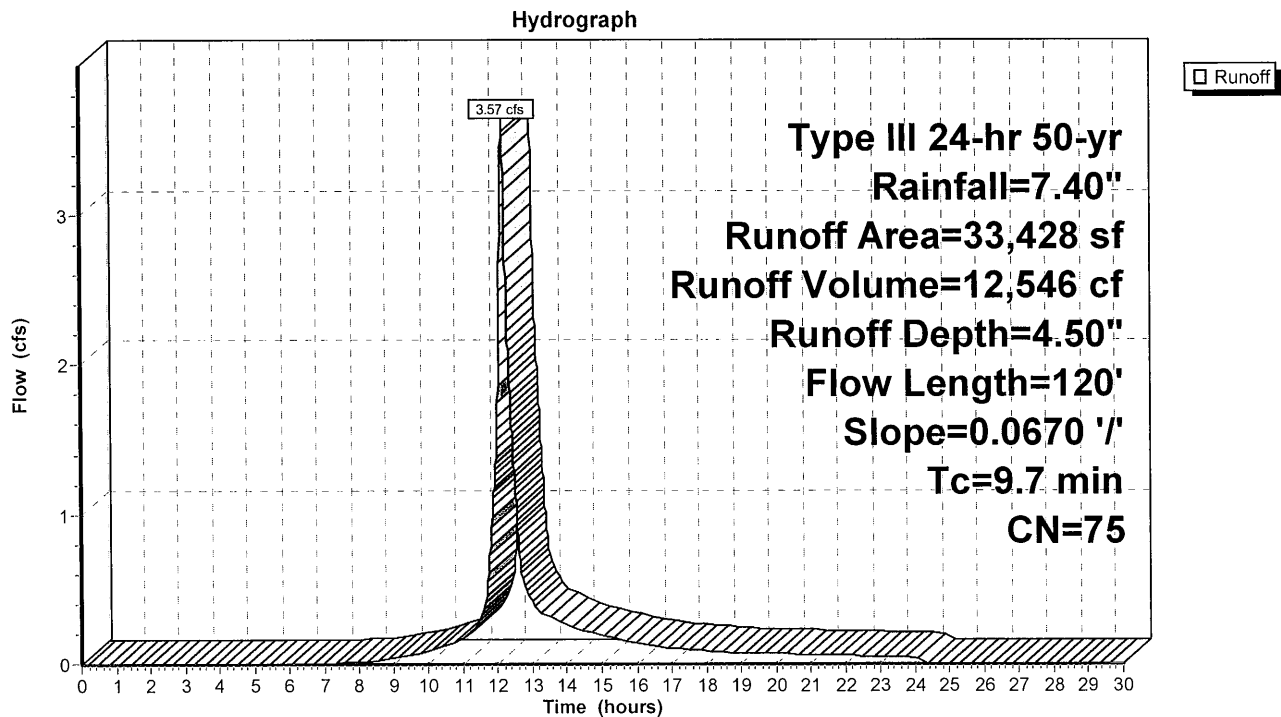
Runoff = 3.57 cfs @ 12.13 hrs, Volume= 12,546 cf, Depth= 4.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-yr Rainfall=7.40"

	Area (sf)	CN	Description
*	345	98	Undetained Driveway
	23,638	74	>75% Grass cover, Good, HSG C
	8,475	76	Woods/grass comb., Fair, HSG C
*	665	98	Rear Patio
*	305	98	Front Walkways
	33,428	75	Weighted Average
	32,113		Pervious Area
	1,315		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	120	0.0670	0.21		Sheet Flow, AB
Grass: Dense n= 0.240 P2= 3.51"					

Subcatchment E1a: Undetained Area



Existing Conditions - 72 Deepwood

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Type III 24-hr 50-yr Rainfall=7.40"

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Summary for Subcatchment E1b: Detained Area

Runoff = 1.10 cfs @ 12.07 hrs, Volume= 3,816 cf, Depth= 7.16"

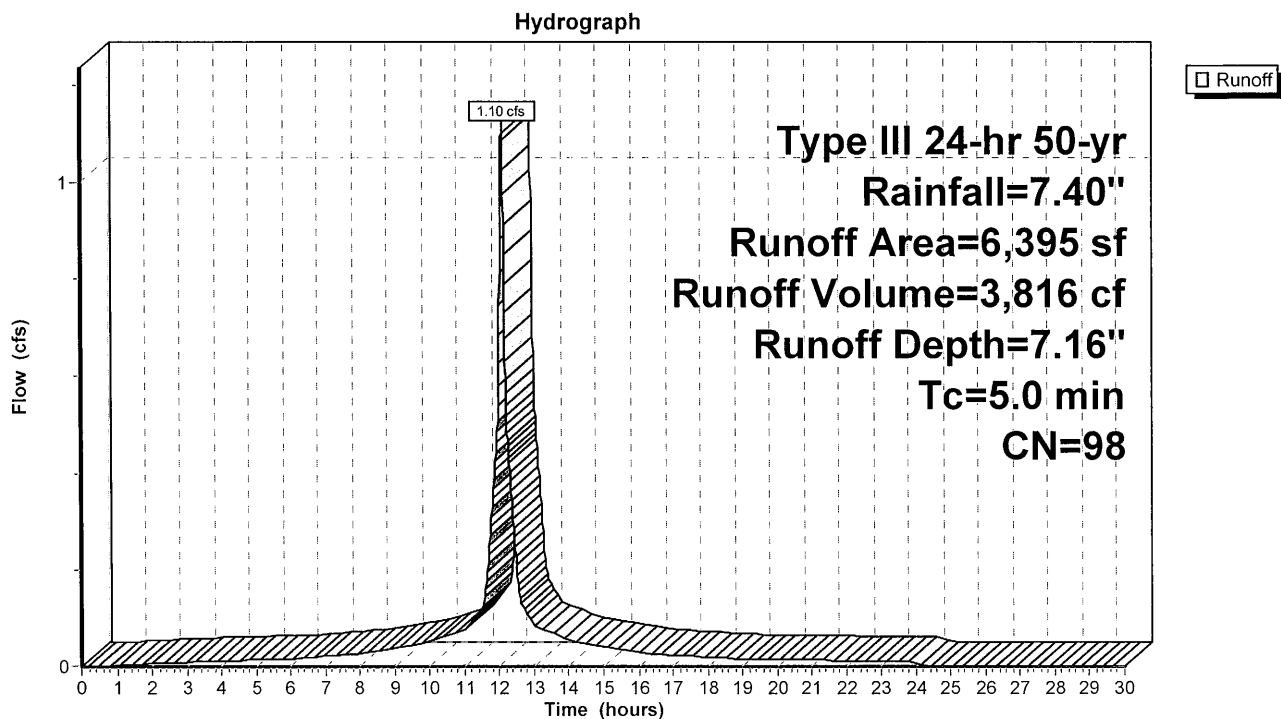
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Type III 24-hr 50-yr Rainfall=7.40"

	Area (sf)	CN	Description
*	3,610	98	Rooftop
*	2,785	98	Driveway
	6,395	98	Weighted Average
	6,395		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum

Subcatchment E1b: Detained Area



Existing Conditions - 72 Deepwood

Type III 24-hr 50-yr Rainfall=7.40"

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Summary for Pond DET: Detention System

Inflow Area = 6,395 sf, 100.00% Impervious, Inflow Depth = 7.16" for 50-yr event
 Inflow = 1.10 cfs @ 12.07 hrs, Volume= 3,816 cf
 Outflow = 0.50 cfs @ 12.22 hrs, Volume= 3,816 cf, Atten= 55%, Lag= 9.2 min
 Discarded = 0.04 cfs @ 9.28 hrs, Volume= 3,186 cf
 Primary = 0.46 cfs @ 12.22 hrs, Volume= 630 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 100.57' @ 12.22 hrs Surf.Area= 900 sf Storage= 1,283 cf

Plug-Flow detention time= 210.8 min calculated for 3,815 cf (100% of inflow)
 Center-of-Mass det. time= 210.8 min (952.1 - 741.3)

Volume	Invert	Avail. Storage	Storage Description
#1	98.00'	480 cf	6.00'W x 50.00'L x 2.60'H Gravel Bed x 3 2,340 cf Overall - 1,140 cf Embedded = 1,200 cf x 40.0% Voids
#2	98.50'	815 cf	48.0"W x 24.0"H x 48.00'L Galley 4x8x2 x 3 Inside #1
		1,295 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	98.00'	2.000 in/hr Exfiltration over Surface area
#2	Primary	100.50'	2.00' x 2.00' Horiz. Overflow Grate Limited to weir flow C= 0.600

Discarded OutFlow Max=0.04 cfs @ 9.28 hrs HW=98.03' (Free Discharge)
 ↑ **1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.45 cfs @ 12.22 hrs HW=100.57' (Free Discharge)
 ↑ **2=Overflow Grate** (Weir Controls 0.45 cfs @ 0.84 fps)

Existing Conditions - 72 Deepwood

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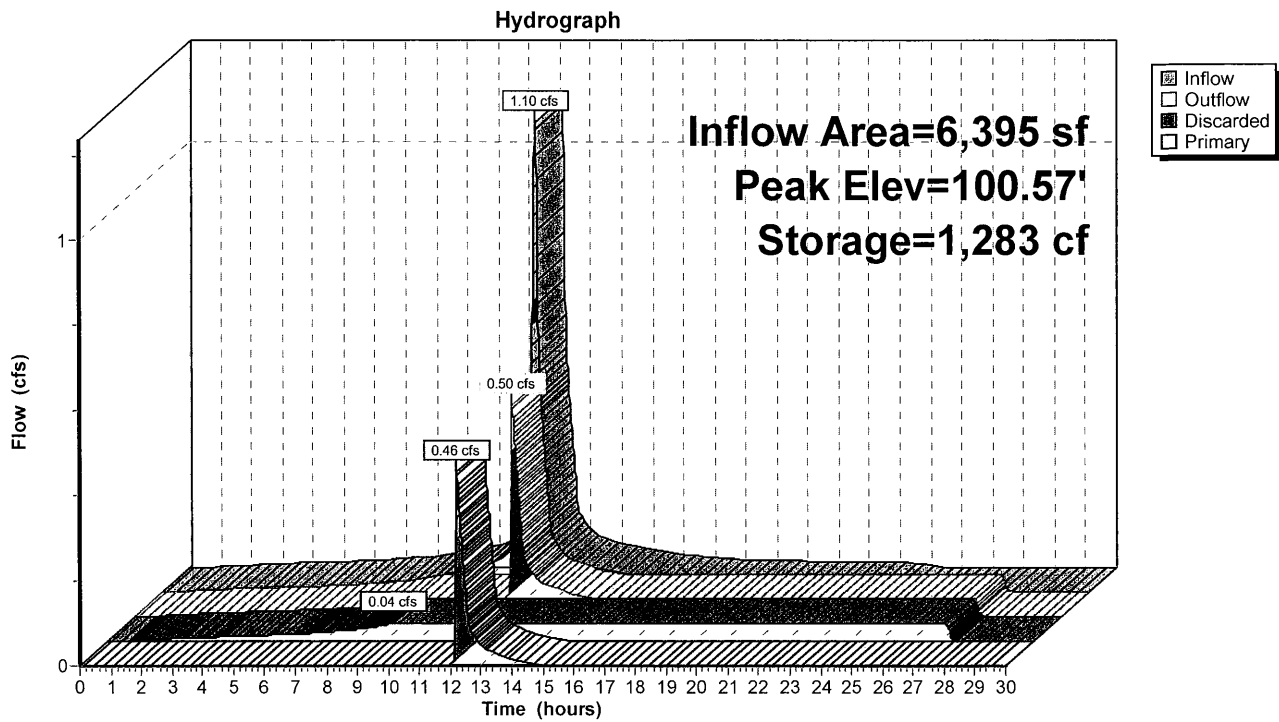
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Type III 24-hr 50-yr Rainfall=7.40"

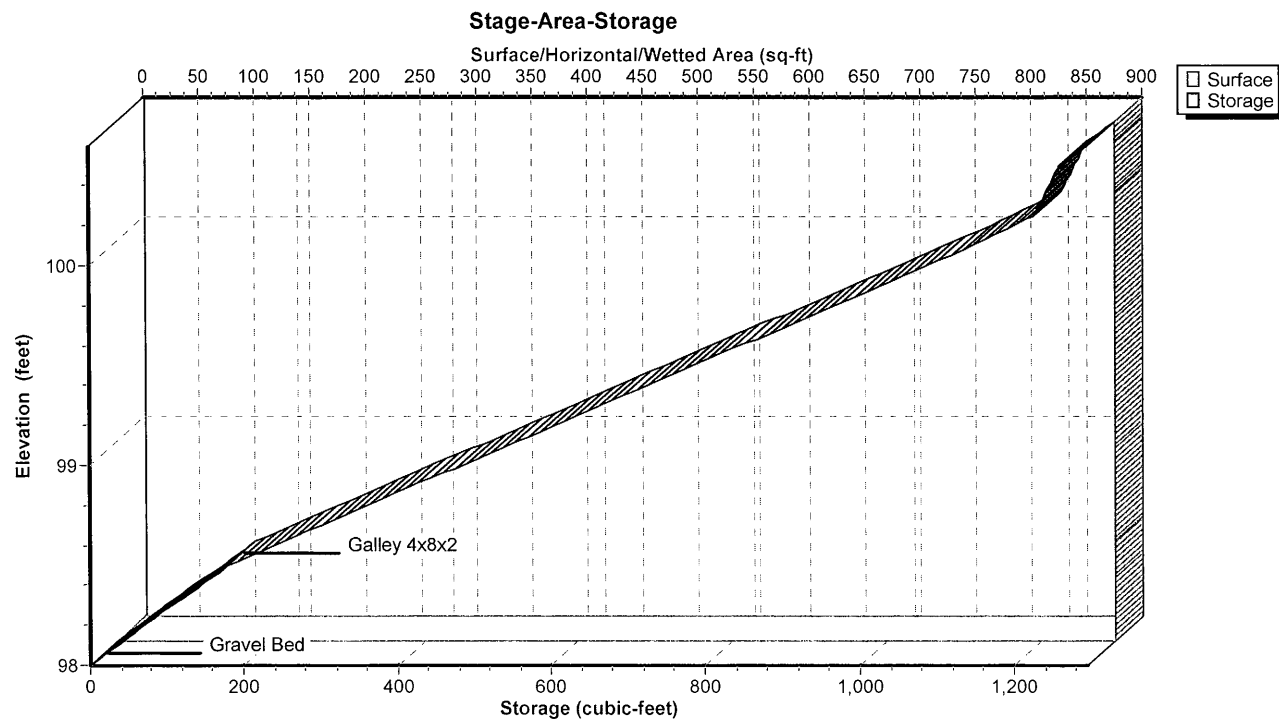
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Pond DET: Detention System



Pond DET: Detention System



Existing Conditions - 72 Deepwood

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Type III 24-hr 50-yr Rainfall=7.40"

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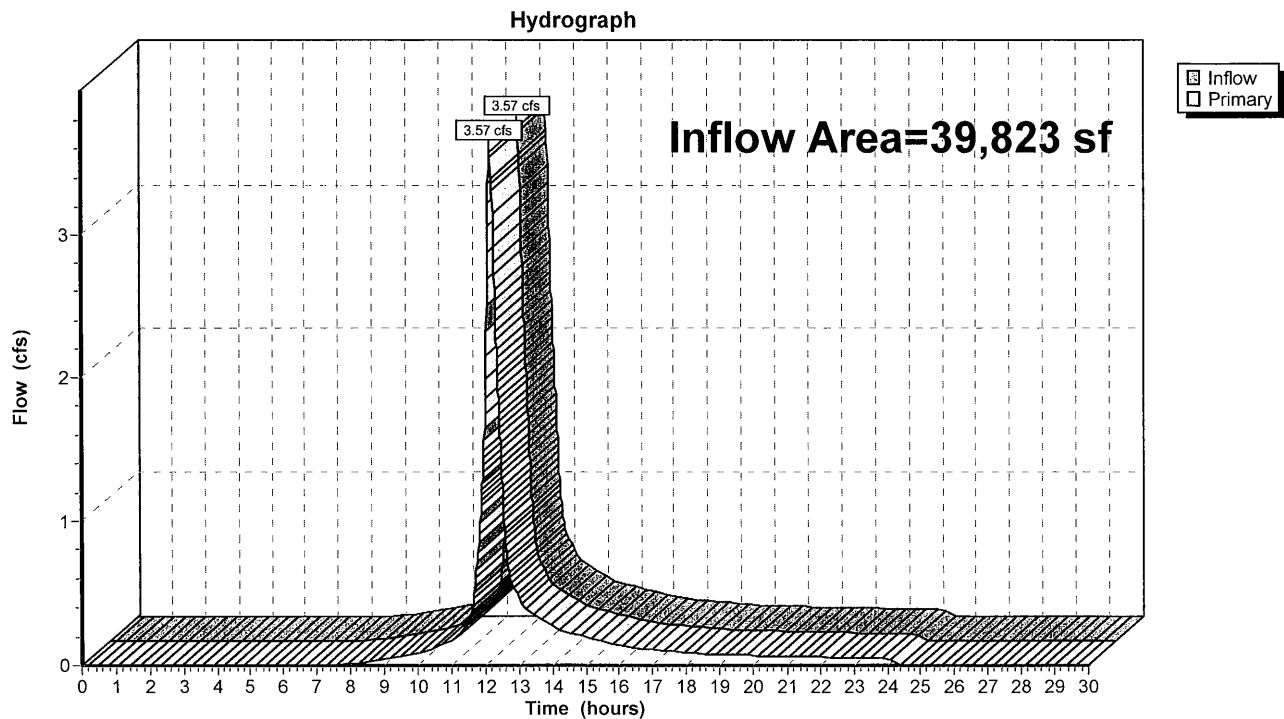
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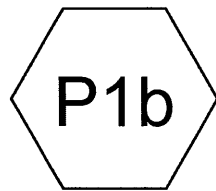
Summary for Link SUM: Sum Hydrographs

Inflow Area = 39,823 sf, 19.36% Impervious, Inflow Depth = 3.97" for 50-yr event
Inflow = 3.57 cfs @ 12.13 hrs, Volume= 13,176 cf
Primary = 3.57 cfs @ 12.13 hrs, Volume= 13,176 cf, Atten= 0%, Lag= 0.0 min

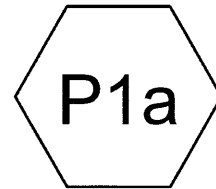
Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link SUM: Sum Hydrographs

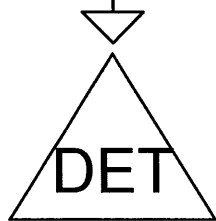




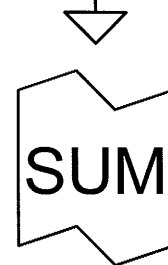
Detained Area



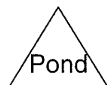
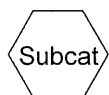
Undetained Area



Detention System



Sum Hydrographs



Proposed Conditions - 72 Deepwood

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
21,383	74	>75% Grass cover, Good, HSG C (P1a)
8,475	76	Woods/grass comb., Fair, HSG C (P1a)
2,785	98	Driveway (P1b)
665	98	Ex Rear Patio (P1b)
305	98	Front Walkways (P1a)
1,345	98	Proposed Patio (P1a,P1b)
810	98	Proposed Pool (P1a)
100	98	Proposed Spa (P1b)
3,610	98	Rooftop (P1b)
345	98	Undetained Driveway (P1a)
39,823		TOTAL AREA

Proposed Conditions - 72 Deepwood

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Type III 24-hr 50-yr Rainfall=7.40"

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Summary for Subcatchment P1a: Undetained Area

Runoff = 3.45 cfs @ 12.13 hrs, Volume= 12,158 cf, Depth= 4.62"

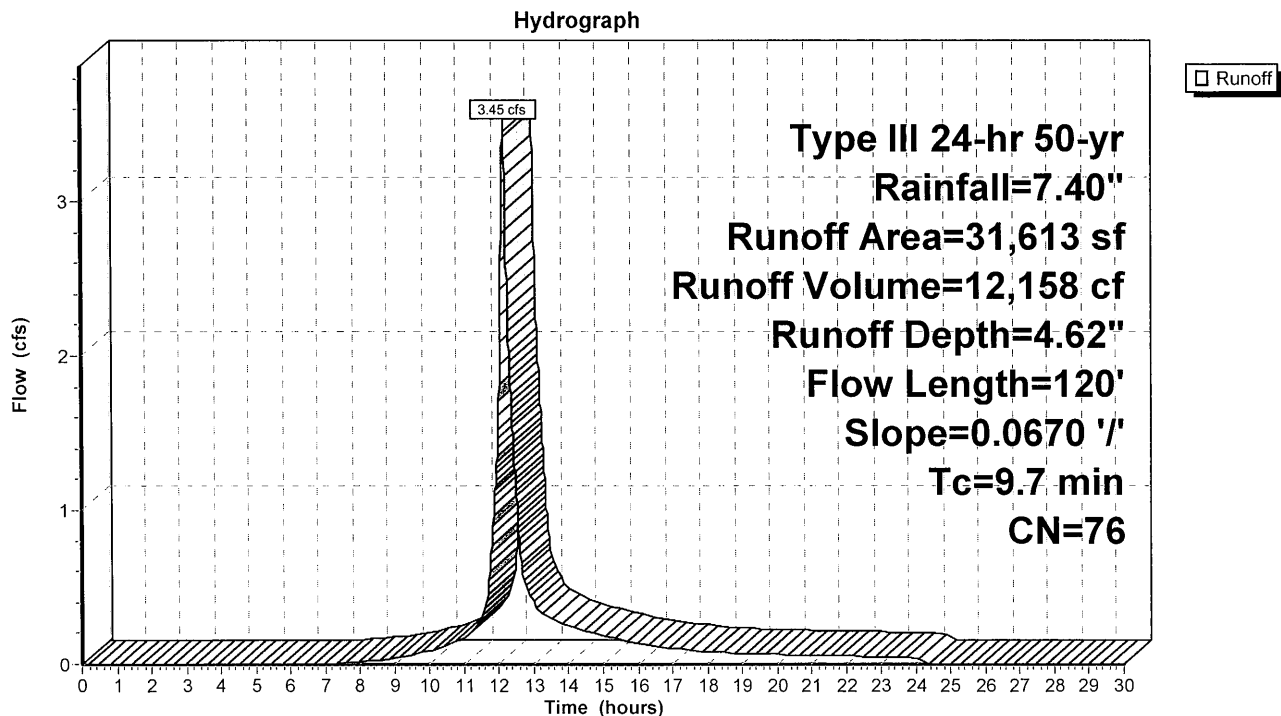
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Type III 24-hr 50-yr Rainfall=7.40"

	Area (sf)	CN	Description
*	345	98	Undetained Driveway
*	305	98	Front Walkways
*	810	98	Proposed Pool
*	295	98	Proposed Patio
	8,475	76	Woods/grass comb., Fair, HSG C
	21,383	74	>75% Grass cover, Good, HSG C
	31,613	76	Weighted Average
	29,858		Pervious Area
	1,755		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	120	0.0670	0.21		Sheet Flow, AB
Grass: Dense n= 0.240 P2= 3.51"					

Subcatchment P1a: Undetained Area



Proposed Conditions - 72 Deepwood

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Type III 24-hr 50-yr Rainfall=7.40"

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Summary for Subcatchment P1b: Detained Area

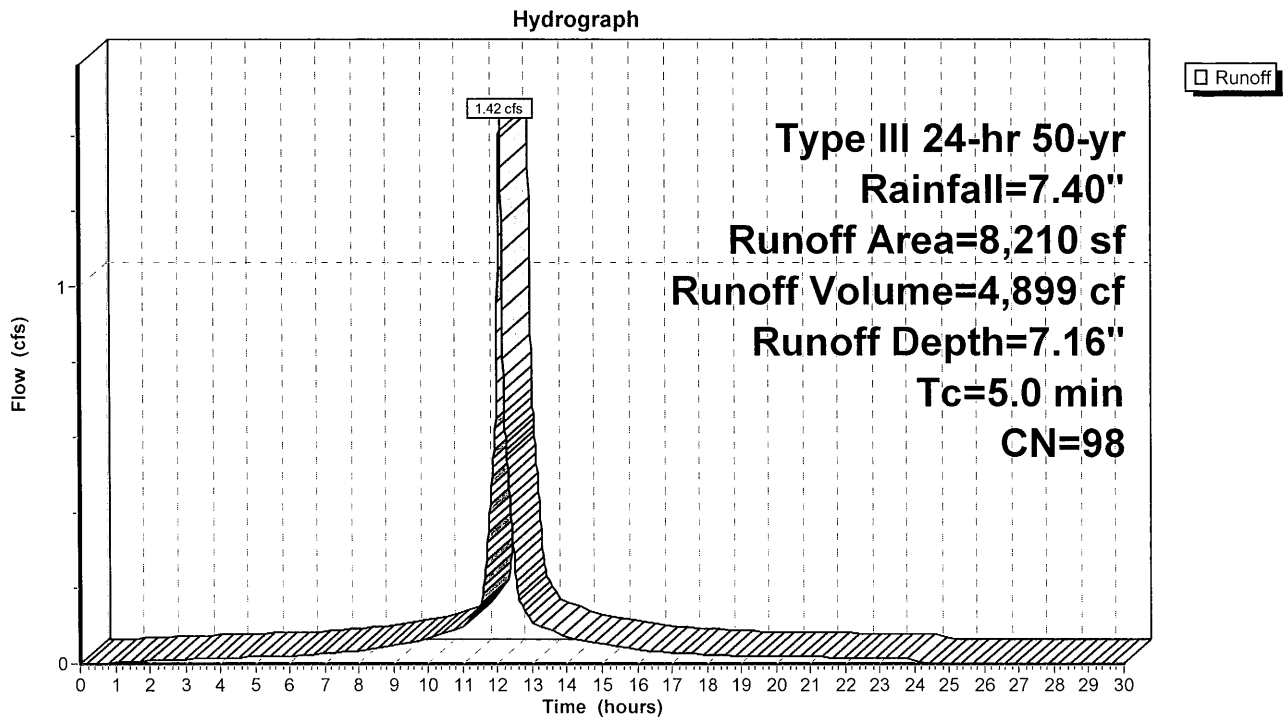
Runoff = 1.42 cfs @ 12.07 hrs, Volume= 4,899 cf, Depth= 7.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Type III 24-hr 50-yr Rainfall=7.40"

	Area (sf)	CN	Description
*	3,610	98	Rooftop
*	2,785	98	Driveway
*	665	98	Ex Rear Patio
*	100	98	Proposed Spa
*	1,050	98	Proposed Patio
	8,210	98	Weighted Average
	8,210		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Minimum

Subcatchment P1b: Detained Area

Proposed Conditions - 72 Deepwood

Type III 24-hr 50-yr Rainfall=7.40"

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Summary for Pond DET: Detention System

Inflow Area = 8,210 sf, 100.00% Impervious, Inflow Depth = 7.16" for 50-yr event
 Inflow = 1.42 cfs @ 12.07 hrs, Volume= 4,899 cf
 Outflow = 0.63 cfs @ 12.22 hrs, Volume= 4,899 cf, Atten= 55%, Lag= 9.3 min
 Discarded = 0.05 cfs @ 9.27 hrs, Volume= 4,081 cf
 Primary = 0.58 cfs @ 12.22 hrs, Volume= 818 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 100.58' @ 12.22 hrs Surf.Area= 1,152 sf Storage= 1,647 cf

Plug-Flow detention time= 210.5 min calculated for 4,899 cf (100% of inflow)

Center-of-Mass det. time= 210.4 min (951.7 - 741.3)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	140 cf	6.00'W x 42.00'L x 2.65'H New Gravel Bed 668 cf Overall - 317 cf Embedded = 351 cf x 40.0% Voids
#2	98.00'	498 cf	6.00'W x 50.00'L x 2.65'H Gravel Bed x 3 2,385 cf Overall - 1,140 cf Embedded = 1,245 cf x 40.0% Voids
#3	98.50'	227 cf	48.0"W x 24.0"H x 40.00'L New Galley 4x8x2 Inside #1
#4	98.50'	815 cf	48.0"W x 24.0"H x 48.00'L Galley 4x8x2 x 3 Inside #2
		1,680 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	98.00'	2.000 in/hr Exfiltration over Surface area
#2	Primary	100.50'	2.00' x 2.00' Horiz. Overflow Grate Limited to weir flow C= 0.600

Discarded OutFlow Max=0.05 cfs @ 9.27 hrs HW=98.03' (Free Discharge)↑ **1=Exfiltration** (Exfiltration Controls 0.05 cfs)**Primary OutFlow** Max=0.57 cfs @ 12.22 hrs HW=100.58' (Free Discharge)↑ **2=Overflow Grate** (Weir Controls 0.57 cfs @ 0.91 fps)

Proposed Conditions - 72 Deepwood

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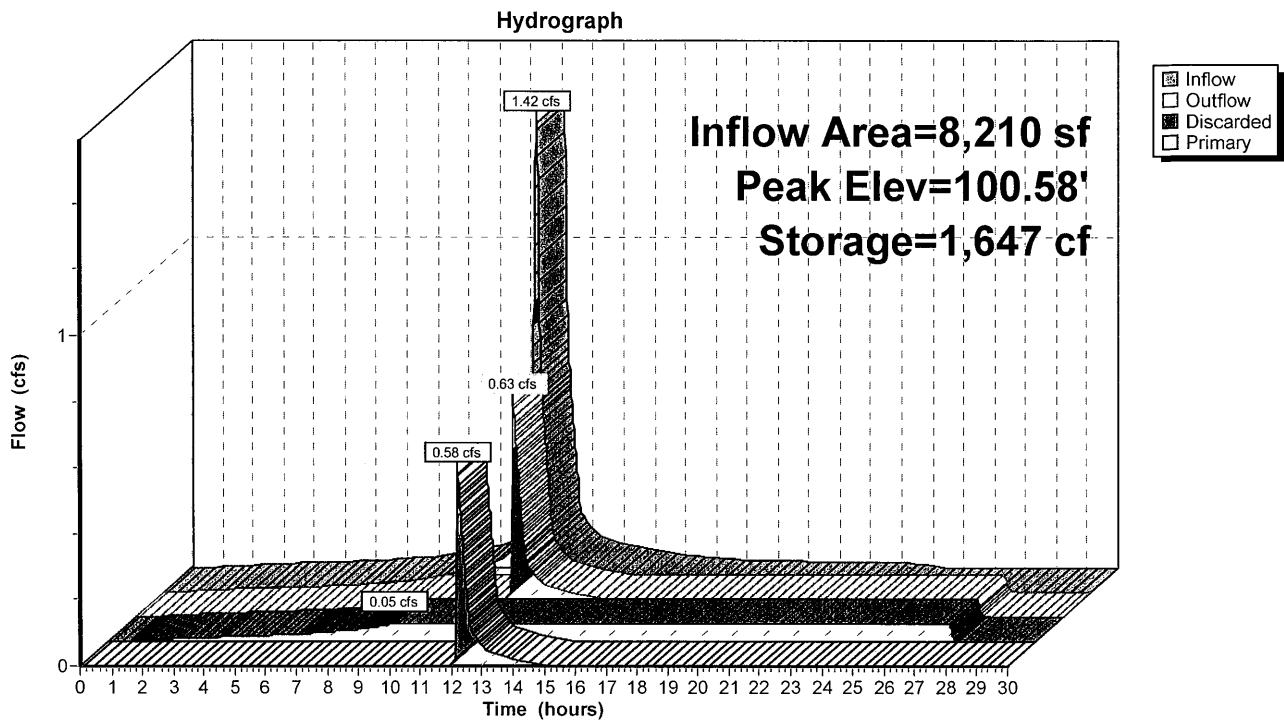
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Type III 24-hr 50-yr Rainfall=7.40"

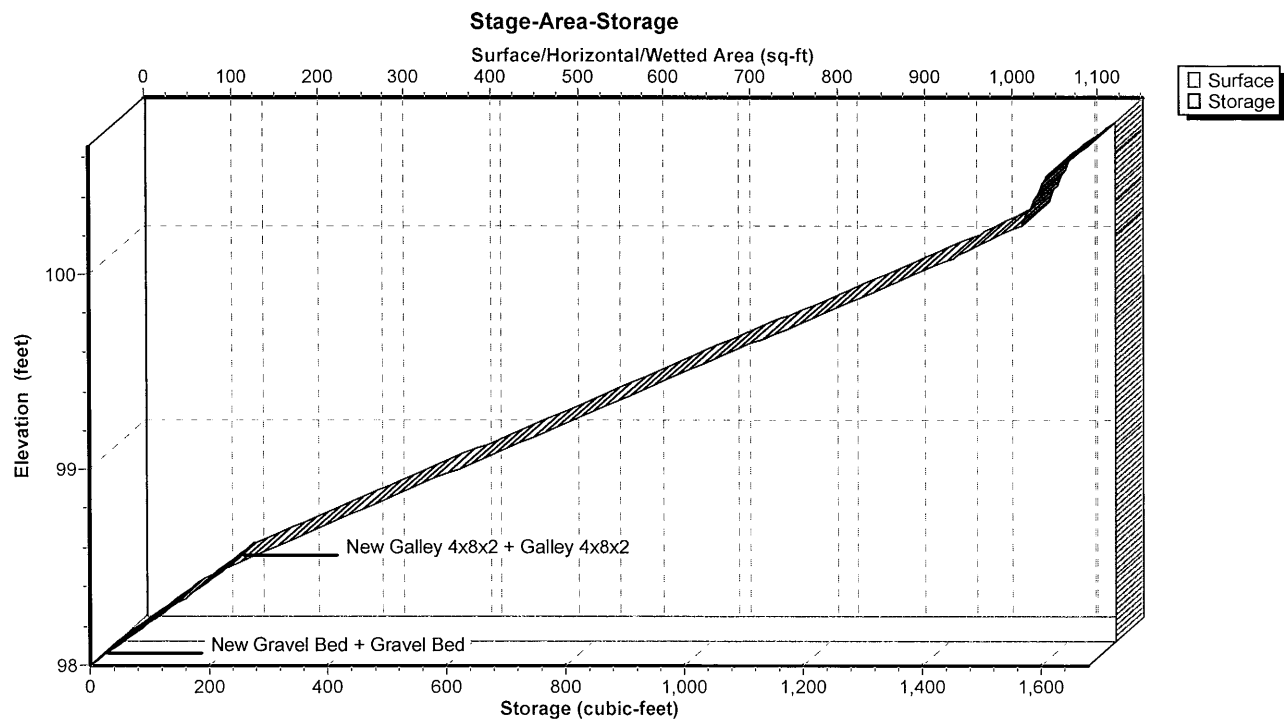
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Pond DET: Detention System



Pond DET: Detention System



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Type III 24-hr 50-yr Rainfall=7.40"

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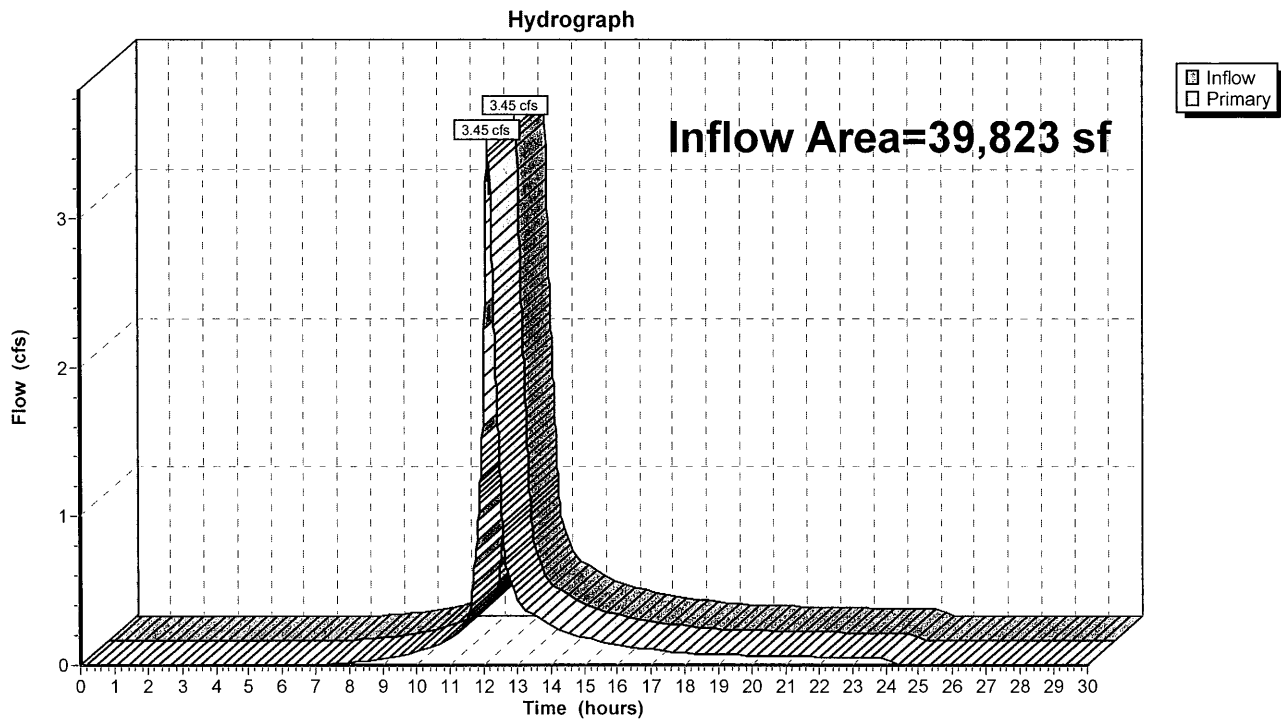
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Summary for Link SUM: Sum Hydrographs

Inflow Area = 39,823 sf, 25.02% Impervious, Inflow Depth = 3.91" for 50-yr event
Inflow = 3.45 cfs @ 12.13 hrs, Volume= 12,976 cf
Primary = 3.45 cfs @ 12.13 hrs, Volume= 12,976 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link SUM: Sum Hydrographs



APPENDIX B:
WATER QUALITY VOLUME COMPUTATIONS

Water Quality Volume Computation

72 Deepwood Road, Darien, CT

AREA OF DEVELOPMENT TO BE CAPTURED BY DETENTION SYSTEM	
Location	Area, (ft ²)
Existing Residence	3,610
Existing Driveway	2,785
Existing Rear Patio	665
Proposed Pool Patio	1,050
Proposed Spa	100

Location	A Area (ft ²)	Imperv. Area (ft ²)	I % Imperv.	R Runoff Coeff.	WQV (ft ³)
Subject Drainage Area	8,210	8,210	100.0	0.950	650

Location	System Description	Volume Provided (ft ³)
Subject Drainage Area	184 LF of 24"x48" Concrete Galleries	1,680

$$WQV = \frac{(1')(R)(A)}{12}$$

where: WQV = water quality volume (ac-ft)
 R = volumetric runoff coefficient
= 0.05+0.009(I)
 I = percent impervious cover
 A = site area in acres

APPENDIX C:
STORMWATER FACILITIES MAINTENANCE PLAN

Stormwater Facilities Maintenance Plan
72 Deepwood Road, Darien, CT
Map 26, Lot 27

Scope:

The purpose of the Stormwater Facilities Maintenance Plan is to insure that the proposed stormwater components installed for the 72 Deepwood Road are maintained in operational condition throughout the life of the home. The service procedures associated with this plan shall be performed as required by the parties legally responsible for their maintenance.

Description of Stormwater Facilities:

The proposed stormwater facilities are designed to collect, convey, detain and treat the runoff from the site in order to minimize adverse impacts to the adjoining lagoon. A description of the stormwater facilities are as follows:

1. **Roof Leaders/Gutters:** Roof leaders (also known as downspouts) from the house will convey roof runoff collected by the roof gutters on the proposed house to the underground detention chambers.
2. **Yard Drains:** One yard drain will collect runoff from the existing swale on the adjacent property to the north and convey it via an underground perforated pipe in gravel trench to another yard drain adjacent to the wetlands. These drains are equipped with a sump designed to capture sediment and debris from the runoff.
3. **Driveway Drains:** Driveway drains will collect runoff from the driveway and convey it to the proposed detention system. Driveway drains are equipped with a sump designed to capture sediment and debris from the runoff.
4. **Underground Detention Chambers:** The underground detention system consists of a series of concrete chambers which provide storage volume for the stormwater runoff. Stormwater in the underground detention system is designed to infiltrate into the underlying soils. The detention chambers are designed to overflow from a grate at the ground surface during extreme storm events.

Recommended Frequency of Service:

All of the stormwater components installed for this property should be checked periodically and kept in full working order. Ultimately the frequency of inspection and service cleaning depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, trash, etc.); however it is recommended that each facility be inspected and cleaned a minimum of two times a year. The guidelines for the timing of service include early spring after the winter season and late fall after the leaves have fallen from the trees.

Service Procedures:

Service can be performed by the homeowner, landscape contractor or handyman since no specialized equipment is required. Specific service procedures for the stormwater facilities are as follows:

1. **Roof Leaders/Gutters:** Roof gutters shall be inspected twice a year during the spring and fall service inspections to ensure that roof leaders are kept free of leaves and debris that could clog the detention chambers. At a minimum, leaves should be cleaned from the gutters during the fall service inspection.
2. **Driveway/Yard Drains:** All drains shall be inspected and cleaned twice a year during the spring and fall service inspections. The cleaning shall include both removal of sediment from the sumps and removal of any trash and/or debris from the grate.
3. **Underground Detention Chambers:** Functionality of the underground detention chambers ultimately depends on keeping sediment and debris out of the chambers. This is accomplished through proper maintenance of the roof leaders and gutters. These components should be maintained as described above, but more frequent maintenance may be required if excessive accumulation of debris is observed. Debris should be removed from the overflow grate during the spring and fall service inspections.